



Smart Grid Standards Information

Version 1.7

Friday, August 20, 2010

Section I: Use and Application of the Standard

Identification and Affiliation

Number of the standard	IEEE Std 1646-2004
Title of the standard	IEEE Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation
Name of owner organization	IEEE
Latest versions, stages, dates	Approved 23 September 2004 by IEEE-SA Standards Board Approved 23 March 2005 by American National Standards Institute
URL(s) for the standard	http://ieeexplore.ieee.org/servlet/opac?punumber=9645
Working group / committee	Task Force C2TF4
Original source of the content (if applicable)	
Brief description of scope	A standard defining communication delivery times of information to be exchanged within and external to substation integrated protection, control, and data acquisition systems is described. Communication capabilities and system capabilities to deliver data on time are also specified.

Level of Standardization

1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	IEEE, ANSI
	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Has it been endorsed or recommended by any level of government? If "Yes", please describe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Level of Standard (check all that apply)	<input type="checkbox"/> International <input checked="" type="checkbox"/> National <input type="checkbox"/> Industry <input type="checkbox"/> de Facto <input type="checkbox"/> Single Company
	Type of document	<input checked="" type="checkbox"/> Standard <input type="checkbox"/> Report <input type="checkbox"/> Guide <input type="checkbox"/> Technical Specification
	Level of Release	<input checked="" type="checkbox"/> Released <input type="checkbox"/> In Development <input type="checkbox"/> Proposed

Section I: Use and Application of the Standard

Areas of Use

1.	Currently used in which domains? (check all that apply)	<input type="checkbox"/> Markets <input type="checkbox"/> Operations <input type="checkbox"/> Service Providers <input type="checkbox"/> Generation <input checked="" type="checkbox"/> Transmission <input checked="" type="checkbox"/> Distribution <input type="checkbox"/> Customer
	Planned for use in which domains? (check all that apply)	<input type="checkbox"/> Markets <input type="checkbox"/> Operations <input type="checkbox"/> Service Providers <input type="checkbox"/> Generation <input type="checkbox"/> Transmission <input type="checkbox"/> Distribution <input type="checkbox"/> Customer
	Please describe the Smart Grid systems and equipment to which this standard is applied	Applies to substation timing performance requirements for communications.

Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	IEEE Std 1588-2002, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.
	Which standards or specifications are related to this standard?	
	Which standards or specifications cover similar areas (may overlap)?	
	What activities are building on this work?	Substation automation builds on the timing performance of communications.

Dept of Energy Smart Grid Characteristics

Please describe how this standard may encourage each of the following:

1.	Enables informed participation by customers	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.	Accommodates all generation and storage options	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
3.	Enables new products, services and markets	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
4.	Provides the power quality for a range of needs	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
5.	Optimizes asset utilization and operating efficiency	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	Operates resiliently to disturbances, attacks, and natural disasters	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Priority Areas Previously Mentioned by FERC and NIST

Please describe if and how this standard may be applied in each of the following areas. Note that there is space in section Error: Reference source not found to discuss any other significant areas where the standard may be applied.

1.	Cybersecurity and physical security	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.	Communicating and coordinating across inter-system interfaces	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
3.	Wide area situational awareness	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Timeliness of data is critical for situational awareness.
4.	Smart grid-enabled response for energy demand	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
5.	Electric storage	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	Electric vehicle transportation	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
7.	Advanced metering infrastructure	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
8.	Distribution grid management	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Openness

1.	Amount of fee (if any) for the documentation	\$102
2.	Amount of fee (if any) for implementing the standard	None
3.	Amount of fee (if any) to participate in updating the standard	None
4.	Is the standard documentation available online?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No URL: http://ieeexplore.ieee.org/servlet/opac?punumber=9645
5.	Are there open-source or reference implementations?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6.	Are there open-source test tools?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.	Would open-source implementations be permitted?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
8.	Approximately how many implementers are there?	
9.	Approximately how many users are there?	
10.	Where is the standard used outside of the USA?	
11.	Is the standard free of references to patented technology?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
12.	If patented technology is used, does the holder provide a royalty-free license to users of the standard?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Patented
13.	Can an implementer use the standard without signing a license agreement?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
14.	Are draft documents available to the public at no cost?	<input type="checkbox"/> Yes <input type="checkbox"/> No
15.	How does one join the working group or committee that controls the standard?	
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Specific balloting committee
17.	Is an ANSI-accredited process used to develop the standard?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
18.	What countries are represented in the working group or committee that controls the standard?	

Support, Conformance, Certification and Testing

1.	Is there a users group or manufacturers group to support this standard?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2.	What is the name of the users group or manufacturers group (if any)?	
3.	What type of test procedures are used to test this standard? (please check all that apply)	<input type="checkbox"/> Internal to the lab <input checked="" type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input type="checkbox"/> No procedures, informal testing
4.	Are there test vectors (pre-prepared data) used in testing? (please check all that apply)	<input type="checkbox"/> Internal to the lab <input checked="" type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input type="checkbox"/> No procedures, informal testing
5.	What types of testing programs exist? (check all that apply)	<input type="checkbox"/> Interoperability Testing <input type="checkbox"/> Conformance Testing <input type="checkbox"/> Security Testing <input type="checkbox"/> No Testing
6.	What types of certificates are issued? (check all that apply)	<input type="checkbox"/> Interoperability Certificate <input type="checkbox"/> Conformance Certificate <input type="checkbox"/> Security Certificate (text document) <input type="checkbox"/> No Certificates
7.	Are there rules controlling how and when to use the logo?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Standard has no logo
8.	Is there a program to approve test labs?	<input type="checkbox"/> Yes <input type="checkbox"/> No
9.	Approximately how many test labs are approved (if any)?	
10.	Is there a defined process for users to make technical comments on the standard or propose changes to the standard and have these issues resolved?	<input type="checkbox"/> Yes <input type="checkbox"/> No
11.	Is there a published conformance checklist or table?	<input type="checkbox"/> Yes <input type="checkbox"/> No
12.	Are there defined conformance blocks or subsets?	<input type="checkbox"/> Yes <input type="checkbox"/> No
13.	Approximately how many vendors provide test tools?	
14.	Are there tools for pre-certification prior to testing?	<input type="checkbox"/> Yes <input type="checkbox"/> No
15.	Can vendors self-certify their implementations?	<input type="checkbox"/> Yes <input type="checkbox"/> No
16.	Is there application testing for specific uses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
17.	Is there a "golden" or "reference" implementation to test against?	<input type="checkbox"/> Yes <input type="checkbox"/> No
18.	Who typically funds the testing? (check all that apply)	<input type="checkbox"/> User <input type="checkbox"/> Users Group <input type="checkbox"/> Vendor <input type="checkbox"/> Confidential
19.	Is there a method for users and implementers to ask questions about the standard and have them answered? (check all that apply)	<input checked="" type="checkbox"/> Yes, official interpretations <input type="checkbox"/> Yes, informal opinions <input type="checkbox"/> No
20.	Does the users' group (or some other group) fund specific tasks in the evolution of the standard?	<input type="checkbox"/> Yes <input type="checkbox"/> No

21.	Is the users' group working on integration, harmonization or unification with other similar standards?	<input type="checkbox"/> Yes <input type="checkbox"/> No
22.	What other standards is this standard being integrated, harmonized, or unified with (if any)?	
23.	Are there application notes, implementation agreements, or guidelines available describing specific uses of the standard?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable

J. Notes

Please present here any additional information about the standard that might be useful:

1.	
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Section II: Functional Description of the Standard

GridWise Architecture: Layers

Please identify which layers this standard specifies, as described in

http://www.gridwiseac.org/pdfs/interopframework_v1_1.pdf, and the applicable section of the standard. Note the mapping to the Open Systems Interconnect (OSI) model is approximate.

1.	Layer 8: Policy	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.	Layer 7: Business Objectives	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
3.	Layer 6: Business Procedures	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
4.	Layer 5: Business Context	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
5.	Layer 4: Semantic Understanding (object model)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	Layer 3: Syntactic Interoperability (OSI layers 5-7)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
7.	Layer 2: Network Interoperability (OSI layers 3-4)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
8.	Layer 1: Basic Connectivity (OSI layers 1-2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

GridWise Architecture: Cross-Cutting Issues

Please provide an explanation in the box beside the heading for any questions answered "Not applicable". If the question is not applicable because the function is provided in another layer or standard, please suggest any likely candidates. Note that "the standard" refers to the technology specified by the standard, not the documents themselves.

	Shared Meaning of Content	
1.	Do all implementations share a common information model?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
2.	Can data be arranged and accessed in groups or structures?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
3.	Can implementers extend the information model?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
4.	Can implementers use a subset of the information model?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
	Resource Identification	
5.	Can data be located using human-readable names?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
6.	Can names and addresses be centrally managed without human intervention?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
	Time Synchronization and Sequencing	
7.	Can the standard remotely synchronize time?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Provided in another layer
8.	Can the standard indicate the quality of timestamps?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Provided in another layer
	Security and Privacy	
9.	Where is security provided for this standard?	<input type="checkbox"/> Within this standard <input checked="" type="checkbox"/> By other standards
10.	Does the standard provide authentication?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
11.	Does the standard permit role-based access control?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Section II: Functional Description of the Standard

12.	Does the standard provide encryption?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
13.	Does the standard detect intrusions or attacks?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
14.	Does the standard facilitate logging and auditing of security events?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
15.	Can the security credentials be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> No Credentials
16.	Can the security credentials be managed centrally?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> No Credentials
17.	Please list any security algorithms and standards used	Standard prioritizes messages in terms of security criticality.
18.	Please provide additional information on how the standard addresses any "Yes" answers above	
19.	Please provide additional information about why any of the questions listed above do not apply to this standard	Standard specifies timing performance requirements; security requirements are appropriately not covered.
Logging and Auditing		
20.	Does the standard facilitate logging and auditing of critical operations and events?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
21.	Can the standard gather statistics on its operation?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
22.	Can the standard report alerts and warnings?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not applicable
Transaction State Management		
23.	Can the standard remotely enable or disable devices or functions?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
System Preservation		
24.	Can the standard automatically recover from failed devices or links?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable <input checked="" type="checkbox"/> Provided in another layer
25.	Can the standard automatically re-route messages?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable <input checked="" type="checkbox"/> Provided in another layer
26.	Can the standard remotely determine the health (as opposed to just connectivity) of devices or software?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not applicable
Other Management Capabilities		
	Please describe any other system or network management capabilities the standard provides.	Specifies timing constraints based on priority, integrity, criticality and security requirements of the data.
Quality of Service		
27.	Is data transfer bi-directional?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
28.	Can data be prioritized?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
29.	What types of reliability are provided?	<input type="checkbox"/> Reliable <input type="checkbox"/> Non-guaranteed <input type="checkbox"/> Both <input type="checkbox"/> Either <input type="checkbox"/> Provided in another layer
30.	Can information be broadcast to many locations with a single transmission?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
	Please describe any other methods the standard uses to manage quality of service.	Incorporates data priority in determining performance requirements.
Discovery and Configuration		

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31.	Can the software or firmware be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
32.	Can configuration or settings be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
33.	Can implementations announce when they have joined the system?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
34.	Can implementations electronically describe the data they provide?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
System Evolution and Scalability		
35.	What factors could limit the number of places the standard could be applied?	
36.	What steps are required to increase the size of a system deploying this standard?	
37.	Is the information model separate from the transport method?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
38.	Does the standard support alternate choices in the layers(s) below it?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No layers below
39.	List the most common technology choices for layers implemented below this standard	
40.	Does the standard support multiple technology choices in the layers above it?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No layers above
41.	List the technologies or entities that would most commonly use this standard in the layer above	
42.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	
43.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	
44.	Please describe how the design of this standard permits it to co-exist on the same network or in the same geographic area with similar technologies, and give examples	
45.	Electromechanical	

Architectural Principles

Please describe how this standard may apply any of these principles:

1.	Symmetry – facilitates bi-directional flow of energy and information	
2.	Transparency – supports a transparent and auditable chain of transactions	
3.	Composition – facilitates the building of complex interfaces from simpler ones	
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	Standard is data model and communication protocol neutral.
5.	Shallow integration – does not require detailed mutual information to interact with other components	

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6.	Please list any other architectural models, reference architectures or frameworks this standard was designed to be compliant with, e.g. W3C, IEC TC57, OSI and how it fits those models	
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